

California Pest Rating Proposal for
***Meloidogyne hispanica* Hirschmann 1986**

Seville root-knot nematode

Current Pest Rating: None

Proposed Pest Rating: A

Comment Period: 12/09/2021 through 01/23/2022

Initiating Event:

This nematode has not been through the pest rating process. The risk to California from *Meloidogyne hispanica* is described herein and a permanent pest rating is proposed.

History & Status:

Background: *Meloidogyne hispanica* is a difficult-to-control polyphagous root-knot nematode species of emerging importance for economically valuable crops. It was described for the first time in Seville, Spain on a peach rootstock and later detected in other areas of the country on beet and grapevines. It has now been detected in multiple countries around the world and its host range continues to expand. A recent detection in South Carolina is the first in North America (Skantar et al., in preparation).

Meloidogyne spp. are obligate, sedentary endoparasites that feed within host plant roots. Adult females embedded in host roots produce eggs within a mass either on the surface of, or within roots. The first stage juvenile develops within the egg and molts to develop into the second stage. The second-stage juveniles (J2) are the infective stage that hatch from eggs and migrate in rhizosphere soil to host roots where they reinfest the same roots they were originally associated with or are attracted to other nearby host roots. The J2s penetrate the host roots and establish a specialized feeding site or giant plant cells that are formed at the head end of the nematode in response to its feeding. They become sedentary while feeding at the specialized site, increase in size and undergo two more molts and non-feeding stages before developing into mature adult females or vermiform males and completing the life cycle.

Hosts: The host range of *M. hispanica* includes plants in the families Amaryllidaceae, Apiaceae, Asteraceae, Brassicaceae, Caryophyllaceae, Chenopodiaceae, Cucurbitaceae, Fabaceae, Rosaceae, Poaceae, and Solanaceae. Important agronomic hosts are eggplant, bean, beets, broccoli, cabbage, corn, cucumber, garlic, grape, lettuce, melon, onion, parsley, pea, potato, stone fruit, spinach, sunflower, tobacco, and wheat (Maleita et al., 2012; Subbotin et al., 2021).

Symptoms: Symptoms of *M. hispanica* attack include severe plant stunting, chlorosis, and extensive root galling (Hirschmann, 1986). Nematode feeding causes cell enlargement and proliferation and leads to the primary symptom of a galled root systems. On some hosts such as tomatoes, galls are obvious and can be up to one inch in diameter. But galled root systems should not be the only diagnostic test, as galls are not always formed, or can be very small, spindle shaped, or in spirals. Galls can also resemble nodules caused by nitrogen-fixing bacteria. Sometimes the primary symptom is a proliferation of lateral root branches rather than galls. On lettuce roots, galls are beadlike. On grasses and onions, galls are usually small swellings and barely noticeable (Mitkowski and Abawi, 2003; Chitambar et al., 2018).

Numerous aboveground symptoms can also be observed, but these are also not diagnostic. Severely affected plants wilt readily, even when soil moisture is sufficient, because galled roots have less ability to absorb and transport water. Nutrient deficiency symptoms including chlorosis can also be observed because of a reduced ability of galled roots to absorb and transport nutrients, even when levels are adequate in the soil. Stunting is a frequent symptom. Heavily infected roots are often badly discolored and rotted. This is due to the invasion of roots by fungi such as *Rhizoctonia*, *Fusarium* and *Pythium* which cause necrosis, and due to the breakdown of galled tissue by bacteria. At high densities or with highly sensitive crops, root-knot nematodes can kill host plants, particularly if the high populations occur early in the growing season when root systems are small. Above ground, symptoms usually appear in clusters of plants or in patches of the field (Mitkowski and Abawi, 2003; Chitambar et al., 2018).

Transmission: Root-knot nematodes move slowly through undisturbed soil and in perennial crops, infestations will gradually radiate outward from an initial point of infection. Cultivation and other practices that move soil and plants will spread root-knot nematodes over longer distances. The length of a root-knot nematode life cycle varies among species but can be as short as two weeks. Nematodes in cooler regions typically have longer life cycles. Eggs may remain inside root tissue or may be released into the soil matrix. Eggs hatch at random and hatching does not require exposure to root exudates. Second-stage juveniles move within the film of water that lines soil pores and are the infective stage. Stylets are used to penetrate root tips at the elongation zone. Once inside the plant root, nematodes migrate towards the vascular cylinder where they establish a feeding site. Once feeding is initiated, they become sedentary and undergo three additional moults to become pear-shaped or nearly spherical adults. The adult female lays 150–250 eggs in a gelatinous matrix on or below the surface of the root. The proportion of males in a population are typically low but may be found toward the end of the growing season, when populations are dense and host plants are under stress (Mitkowski and Abawi, 2003; Chitambar et al., 2018).

Damage Potential: *Meloidogyne* feeding causes a decrease in the size of the root system. Depending upon the host and the number of nematodes present, galls vary in size from minute to extremely large. Galls on trees and vines, are typically smaller than those on herbaceous plants. Infections can also be an aesthetic problem on plant parts that grow underground. Aboveground symptoms include stunting, loss of quantity and quality of yield, wilting during hot periods of the day, and increased susceptibility to foliage and wilt diseases (Mitkowski and Abawi, 2003).

Worldwide Distribution: Africa: *Burkina Faso, Malawi, South Africa*; Asia: *China, Iran, Korea*; Europe: *Greece, The Netherlands, Portugal, Spain*; North America: *USA (South Carolina)*; Central America and Caribbean: *Costa Rica, Martinique*; South America: *Brazil, Ecuador, French Guiana*; and Oceania: *Australia, Fiji* (CABI-ISC, 2021; Maleita et al, 2012; Subbotin et al., 2021; Skantar et al., in preparation).

Official Control: *Meloidogyne hispanica* is on the USDA PCIT's harmful organism list for Chile (USDA, 2021), and it is on the EPPO's A1 list for Argentina and Chile (EPPO, 2021).

California Distribution: none

California Interceptions: none

The risk *Meloidogyne hispanica* would pose to California is evaluated below.

Consequences of Introduction:

- 1) Climate/Host Interaction:** This nematode has been found in tropical and subtropical climates and is likely to be capable of establishing wherever its hosts can grow.

Evaluate if the pest would have suitable hosts and climate to establish in California.

Score: 3

- Low (1) Not likely to establish in California; or likely to establish in very limited areas.
- Medium (2) may be able to establish in a larger but limited part of California.
- **High (3) likely to establish a widespread distribution in California.**

- 2) Known Pest Host Range:** The host range of *M. hispanica* is very large, with hosts in many diverse families.

Evaluate the host range of the pest.

Score: 3

- Low (1) has a very limited host range.
 - Medium (2) has a moderate host range.
 - **High (3) has a wide host range.**
-

- 3) Pest Reproductive Potential:** Root knot nematode females can produce hundreds of eggs. Dispersal depends on the movement of infested plants or soils

Evaluate the natural and artificial dispersal potential of the pest.

Score: 2

- Low (1) does not have high reproductive or dispersal potential.
- **Medium (2) has either high reproductive or dispersal potential.**
- High (3) has both high reproduction and dispersal potential.

- 4) Economic Impact:** Damage can be direct from nematode feeding and gall formation on the roots, or indirect as plants become more susceptible to attack from other types of pathogens

Evaluate the economic impact of the pest to California using the criteria below.

Economic Impact: A, B, C, G

- A. The pest could lower crop yield.**
- B. The pest could lower crop value (includes increasing crop production costs).**
- C. The pest could trigger the loss of markets (includes quarantines).**
- D. The pest could negatively change normal cultural practices.
- E. The pest can vector, or is vectored, by another pestiferous organism.
- F. The organism is injurious or poisonous to agriculturally important animals.
- G. The organism can interfere with the delivery or supply of water for agricultural uses.**

Economic Impact Score: 3

- Low (1) causes 0 or 1 of these impacts.
- Medium (2) causes 2 of these impacts.
- **High (3) causes 3 or more of these impacts.**

- 5) Environmental Impact:** *Meloidogyne hispanica* is polyphagous, with a host range. Once established in the soil, they are very difficult to eradicate

Evaluate the environmental impact of the pest to California using the criteria below

Environmental Impact: A, E

- A. The pest could have a significant environmental impact such as lowering biodiversity, disrupting natural communities, or changing ecosystem processes.**
 - B. The pest could directly affect threatened or endangered species.
 - C. The pest could impact threatened or endangered species by disrupting critical habitats.
 - D. The pest could trigger additional official or private treatment programs.
 - E. The pest significantly impacts cultural practices, home/urban gardening or ornamental plantings.**
-

Environmental Impact Score: 3

- Low (1) causes none of the above to occur.
- Medium (2) causes one of the above to occur.
- High (3) causes two or more of the above to occur.

Consequences of Introduction to California for *Meloidogyne hispanica*: 14

Add up the total score and include it here.

- Low = 5-8 points
- Medium = 9-12 points
- High = 13-15 points

- 6) **Post Entry Distribution and Survey Information:** Evaluate the known distribution in California. Only official records identified by a taxonomic expert and supported by voucher specimens deposited in natural history collections should be considered. Pest incursions that have been eradicated, are under eradication, or have been delimited with no further detections should not be included.

Evaluation is 'not established'.

Score: 0

-Not established (0) Pest never detected in California or known only from incursions.

-Low (-1) Pest has a localized distribution in California or is established in one suitable climate/host area (region).

-Medium (-2) Pest is widespread in California but not fully established in the endangered area, or pest established in two contiguous suitable climate/host areas.

-High (-3) Pest has fully established in the endangered area, or pest is reported in more than two contiguous or non-contiguous suitable climate/host areas.

- 7) **The final score is the consequences of introduction score minus the post entry distribution and survey information score: (Score)**

Final Score: *Score of Consequences of Introduction – Score of Post Entry Distribution and Survey Information = 14*

Uncertainty:

Meloidogyne hispanica can be difficult to distinguish from *M. arenaria* using morphological characters even by experts because these species are quite similar in morphological and biological traits. Molecular characterization using rDNA allows for a sensitive discrimination between species (Landa et al., 2008; Subbotin et al., 2021).

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Meloidogyne hispanica* is A.

References:

- CABI Invasive Species Compendium 2021. *Meloidogyne hispanica*. cabi.org/isc/datasheet/73057187 Accessed 11/9/21
- Chitambar, J. J., Westerdahl, B. B., and Subbotin, S. A. 2018. Plant Parasitic Nematodes in California Agriculture. In Subbotin, S., Chitambar J., (eds) Plant Parasitic Nematodes in Sustainable Agriculture of North America. Sustainability in Plant and Crop Protection. Springer, Cham.
- EPPO Global Database. 2021. *Meloidogyne hispanica* <https://gd.eppo.int/taxon/MELGHI>. Accessed 11/9/21
- Hirschmann, H., 1986. *Meloidogyne hispanica* n. sp. (Nematoda: Meloidogynidae), the 'Seville root-knot nematode'. Journal of Nematology, 18(4), p.520.
- Landa, B.B., Rius, J.E.P., Vovlas, N., Carneiro, R.M., Maleita, C.M., de O. Abrantes, I.M. and Castillo, P., 2008. Molecular characterization of *Meloidogyne hispanica* (Nematoda, Meloidogynidae) by phylogenetic analysis of genes within the rDNA in *Meloidogyne* spp. Plant Disease, 92(7), pp.1104-1110.
- Maleita, C.M.N., Curtis, R.H.C., Powers, S.J. and Abrantes, I., 2012. Host status of cultivated plants to *Meloidogyne hispanica*. European Journal of Plant Pathology, 133(2), pp.449-460.
- Mitkowski, N.A. and G.S. Abawi. 2003. Root-knot nematodes. The Plant Health Instructor. DOI:10.1094/PHI-I-2003-0917-01. Revised 2011.
- Skantar, A. M., Handoo, Z. A., Subbotin, S. A., Kantor, M. R., Vieira, P., Aguedelo, P., Hult, M. N., and Rogers, S. Molecular and morphological evidence for the first report of Seville root-knot nematode, *Meloidogyne hispanica* (Nematoda: Meloidogynidae) in the USA and North America. In preparation.
- Subbotin, S.A., Rius, J.E.P. and Castillo, P., 2021. Systematics of Root-Knot Nematodes (Nematoda: Meloidogynidae). Brill.
- USDA Phytosanitary Certificate Issuance and Tracking System, Phytosanitary Export Database (PEXD) Harmful Organisms Database Report. *Meloidogyne hispanica*. Accessed 11/9/2021

Responsible Party:

Heather J. Scheck, Primary Plant Pathologist/Nematologist, CDFFA/PHPPS ECOPERS, 1220 N St Rm 221, Sacramento, CA 95814 Phone: (916) 654-1017, [permits\[@\]cdfa.ca.gov](mailto:permits[@]cdfa.ca.gov).

***Comment Period: 12/09/2021 through 01/23/2022**

***NOTE:**

You must be registered and logged in to post a comment. If you have registered and have not received the registration confirmation, please contact us at [permits\[@\]cdfa.ca.gov](mailto:permits[@]cdfa.ca.gov).

Comment Format:

- ❖ Comments should refer to the appropriate California Pest Rating Proposal Form subsection(s) being commented on, as shown below.

Example Comment:

Consequences of Introduction: 1. Climate/Host Interaction: [Your comment that relates to “Climate/Host Interaction” here.]

- ❖ Posted comments will not be able to be viewed immediately.
 - ❖ Comments may not be posted if they:
 - Contain inappropriate language which is not germane to the pest rating proposal;
 - Contains defamatory, false, inaccurate, abusive, obscene, pornographic, sexually oriented, threatening, racially offensive, discriminatory or illegal material;
 - Violates agency regulations prohibiting sexual harassment or other forms of discrimination;
 - Violates agency regulations prohibiting workplace violence, including threats.
 - ❖ Comments may be edited prior to posting to ensure they are entirely germane.
 - ❖ Posted comments shall be those which have been approved in content and posted to the website to be viewed, not just submitted.
-

Proposed Pest Rating: A
